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PROJECT FOR THE ANALYSIS OF TECHNOLOGY TRANSFER

THE INITIAL YEAR

DENVER RESEARCH INSTITUTE | UNIVERSITY OF DENVER

PROJECT FOR THE ANALYSIS OF TECHNOLOGY TRANSFER - THE INITIAL YEAR

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PREFACE

Project Purposes

The primary purpose of the Project for the Analysis of Technology Transfer (PATT) is to provide data on the secondary uses made of National Aeronautics and Space Administration (NASA) and Atomic Energy Commission (AEC) developed technology, and to provide a better understanding of the technology transfer process. The initial year's objectives were to identify cases of space technology transfer, to document the circumstances surrounding the use of technical information developed in the space program, to design and implement a Transfer Data Bank, and to analyze the resulting data to assist NASA with technology transfer activities. This report describes how these objectives were fulfilled.

The report is divided into three general categories: (1) a background discussion about technology transfer including an introduction to PATT, (2) a brief description of the research activities, contents of earlier reports, and resulting publications, and (3) data collected over the first year of the program, and certain analyses and recommendations related to these data.

Acknowledgments

We extend our appreciation to the people who contributed to the research and to the preparation of this report, especially to the many unnamed individuals who completed questionnaires which created and thus provided the key information for the PATT data base. Further, numerous industrial and government employees gave time to be interviewed by Denver Research Institute (DRI) staff enabling the documentation of many cases of information usage. Acknowledgment is made also of the assistance of officials in a number of Federal agencies and private organizations. Technology Utilization Officers were especially helpful and cooperative.

John G. Welles, Head, Industrial Economics Division, and John S. Gilmore, Senior Research Economist, both of DRI, assisted in every phase of this project. Their counsel was extremely valuable.

M. Terry Sovel, Carl von E. Bickert, John J. Ryan and J. Gordon Milliken of DRI's Industrial Economics Division were significant contributors. Robert H. Otten and George E. Hayo, graduate

students within the University of Denver's College of Business Administration, aided in data analysis and case preparation. Robert Venuti, Assistant Director for Operations with Denver Research Institute, served as Chairman of the University of Denver's Panel of Advisors to PATT. Philip Wright of the New England Research Application Center aided in the smooth transition of the project from the University of Maryland. Dr. William H. Clingman, a management and technology consultant, performed research related to Tech Brief titles and indexing.

Millie Clarke, Nancy Howie, Barbara Stevenson, Nancy Gundersen, Mary Lee Lance, Eileen Toy, Beverly Price, and Diane Kowalski were responsible for the development of a large data base in the Transfer Data Bank.

Throughout the project, Richard J. H. Barnes of the Technology Utilization Division, National Aeronautics and Space Administration, was an exceptionally able and thoughtful source of administrative support and guidance.

The responsibility for the contents of this report resides with the authors.

TABLE OF CONTENTS

SUMMARY

Accomplishments

During its first year, the major emphasis of the Project for the Analysis of Technology Transfer (PATT) was the design and operation of a follow up program on requests for Technical Support Packages of Tech Briefs. A data bank containing more than 18,000 cases has been established, and more than 11,000 cases have been statistically analyzed. Approximately 300 telephone and personal follow ups to identify examples of technology transfer and information usage have also been carried out. The Quarterly Evaluation Reports have included descriptions of 292 case follow ups.

Other aspects of the first year PATT research program which have been completed or initiated include establishment of a library on technology transfer (including over 1,000 titles), an analysis of NASA readership survey cards, a follow up experiment on NASA patent licensees, publication of a selected bibliography, and preparation of a course outline for 10 class hours of undergraduate level instruction in technological administration. An experiment aimed at measuring the usefulness (as perceived by one research organization) of a NASA Regional Dissemination Center's services is nearing completion with the report planned for early 1969.

Major Findings

More than half of the 11,000 persons surveyed returned a completed questionnaire evaluating the Technical Support Package (TSP) they had previously ordered. The responses indicated that:

1. Over 58 percent learned of the availability of the TSP from NASA Tech Briefs or other NASA publications. The trade press and professional journals accounted for 28 percent of the TSP requests.

2. Over 80 percent said that the TSP was of at least limited value to their work; 8 percent said the TSP provided information of great value or resulted in a commercial product or new process.

3. The median number of hours spent reviewing, studying, or applying the information contained in the TSP was two hours; the mean was 9.4 hours. In total, it is estimated that over 160,000 hours were spent by TSP users in 1968.

4. The ratings of completeness, clarity, and usefulness of TSP's were high--most evaluations were in the good to excellent category. The report presents ratings of TSP's for each NASA center and for selected Tech Briefs.

Among the various industrial categories, firms in the Electrical Machinery industry most frequently requested TSP's (20.6 percent of all TSP requests originated from this industry). Educational Services was second with 9.4 percent followed by Nonelectrical Machinery (7.8 percent), Chemicals (7.5 percent), and the Federal Government (7.1 percent).

Over one-third of all requests for TSP's came from firms with more than 10,000 employees. Firms with fewer than 100 employees accounted for 7.8 percent of all requests.

Of the 2,092 Tech Briefs published prior to April, 1968, 902 stimulated requests (during the study period) for support documents. Eighty-nine of the Tech Briefs elicited 25 or more requests for TSP's. These 89 Tech Briefs accounted for over 70 percent of the cases in the data bank. A separate analysis of the high volume Tech Briefs is included in this report.

Preliminary Observations

Based on the first year's effort, some preliminary observations are drawn:

1. More critical reviews might be made of Mechanical Tech Briefs prior to publication to increase their usefulness.

2. More attention might profitably be given to the opportunities to transfer technology through the educational system. Substantial benefits appear possible from well-conceived efforts in this area.

3. Emphasis should be placed on the continual upgrading of Technical Support Packages to increase the attractiveness of their use by technical information seekers. Quality control measures would become even more important if fees were to be charged for TSP's.

4. Greater awareness and use of TSP's might be encouraged by employing additional emphases or techniques:

   a. Make increased use of the business press to publicize documents having the character of reference works or those which describe materials inventions.

   b. Intensify efforts to identify effective ways to disseminate technical information to firms with under 500 employees.

   c. Increase efforts to make state and local governments more aware of applicable management technology.

   d. Select for special dissemination efforts such industries as apparel, air transportation, construction, food products, and mining which have made relatively little use of TSP's. Attempts might be made to identify relevant technologies for these industries and to create awareness of their availability through communication channels conventionally used by the industries.

SECTION I. BACKGROUND AND INTRODUCTION

This section briefly describes the development of increasing interest in the technology transfer process and discusses NASA activities in this field. The circumstances that led to the creation of the Project for the Analysis of Technology Transfer are reviewed.

A large mass of scientific and technological information is being generated in Federal Government-sponsored research and development (R&D) programs. The majority of it comes from mission oriented R&D in the fields of national defense, space, and atomic energy. It is applicable primarily to these specialized missions.

The public has been encouraged to think of both technology and science as being widely useful. This is particularly true of government-sponsored R&D, and broad usefulness has been a traditional justification for such sponsorship. It is understandable that the public is conditioned to expect visible benefits from the almost $16 billion spent annually on tax-supported R&D. This expectation has been reinforced by occasional justification of the spending by assurances of "fallout," "spin-off" and other terms indicating secondary applications, in addition to those related to primary missions. This belief is further supported by the evident effects of new technology on American life.

The public interest in R&D has been translated into specialized concerns. Government policy and decision makers and scholars show increasing interest in R&D administration in general. A few in each category have become interested in optimizing secondary applications of R&D--in improving technology transfer. As an earlier NASA research project reported:

> The logic behind efforts to accelerate such technological transfer is straightforward: Increased application of technology in the commercial sector of the U.S. economy is generally accepted as a desirable economic objective. Well over half of the nation's research and development resources are being devoted to military and space programs; much new technology is being generated by these efforts. Some should have commercial application and, for the economy to receive optimum benefit of this

technology, it should be applied in both the government and commercial sectors.*

Study groups and researchers have increasingly sought to define technology transfer, to determine the role of government in the process, and to explore, measure, and improve the process itself. Scientists and engineers have examined the process. Economists have identified technology as a factor of production like land, labor, and capital, and they have begun to examine the mobility and value of this factor. They have further concerned themselves with interrelationships among technology transfer, patents, and monopoly. Lawyers have directed their attention to the problems of patent policy. Sociologists have influenced work in the other disciplines by pioneering studies in the diffusion of scientific and technological information. Librarians and data processing specialists have combined forces to improve indexing and retrieval of scientific and technological information.

Several government agencies have historically taken direct action to enhance technology transfer. The Departments of Interior, Agriculture, and Commerce have long histories of making their research results available. The major new problems of technology transfer relate to secondary use--the enhancement of non-defense and non-space use of R&D defense, space, and atomic energy programs.

The Atomic Energy Commission, shortly after its establishment, initiated a program for technical information dissemination. The Department of Commerce distributes unclassified defense R&D reports, as well as those from other agencies. Commerce is also working to make government R&D results locally available through its Office of State Technical Services. The Small Business Administration (SBA) has enlarged its activities in the field. The most comprehensive program for technology transfer, however, is that of the National Aeronautics and Space Administration.

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*John G. Welles, et al., The Commercial Application of Missile/Space Technology (Denver, Colorado: University of Denver Research Institute, 1963), p. v.

According to former NASA Administrator James E. Webb:

> . . . a clear directive from Congress and the President sets NASA the objective of extracting knowledge from its scientific and technological program and making this knowledge available to the maximum extent for the nation's industrial development.*

The Technology Utilization Division (TUD) is the NASA organization responsible for this function. TUD's program includes three general functions:

1. Publications--technical reports and documents (including Tech Briefs).

2. Services--such as Regional Dissemination Centers, Technology Utilization Field Offices, Biomedical Applications Teams, cooperative programs.

3. Special techniques--for instance, conferences, research sponsorship, short courses.

Technology transfer is also encouraged by NASA activities other than the TUD program. These include a variety of conferences sponsored by NASA field facilities, papers and publications by NASA staff, and press releases.

Of particular interest in the context of this statement of background is the TUD research sponsorship function. This research has documented the existence of space technology transfer, and categorized the examples.** It has worked toward evaluation of alternative methods of dissemination, and it has explored the information acquisition behavior of industrial research and engineering personnel. Most of this prior TUD research, and the bulk of the other research mentioned earlier, has been accomplished on an ad hoc basis.

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*James E. Webb, "Commercial Use of Space Research and Technology," Astronautics and Aeronautics, June 1964, p. 74.

**Recognized categories include: (1) stimulation of basic and applied research, (2) new or improved processes and techniques, (3) product improvement, (4) enhanced materials and equipment availability, (5) new products, and (6) cost reduction.

Given the growing interest in effective technology transfer, it appeared proper to consider mechanisms for effective and continuing study of the technology transfer process, integration of knowledge from the varied approaches already underway, and analysis of such work from the standpoint of the public interest in technology transfer. The Project for the Analysis of Technology Transfer (PATT), initiated in November 1967, was designed to help meet this need.

Emphasis was placed during the first year of the PATT effort on: (1) collection of potentially useful data on actual or potential cases of technology transfer resulting from portions of NASA's Technology Utilization Program; (2) classification of data; (3) storage of data so that they can be retrieved for analysis; and (4) preliminary analysis.

The primary purpose of PATT is to perform research on the technology transfer process in such a manner as to enhance the effectiveness of NASA's technology transfer program. Specifically, the objectives of PATT for the first year were:

1. To document actual and potential cases of information use and transfer of space-related technology in secondary uses that result from NASA's Tech Brief program, and, where feasible, to evaluate these cases in terms of:

   a. Identification of incentives and barriers both within and across organizational, industry, and disciplinary boundaries.

   b. Identification of common themes or patterns in the technology transfer process which occur for types of individuals, kinds of new technology, or types of organizations.

2. To establish and maintain a Transfer Data Bank which serves the needs of NASA Headquarters' personnel and PATT's research staff, and which can be used by other researchers of the technology transfer process.

3. To initiate the development of criteria for selecting space-related technology most appropriate for dissemination to selected classes of potential secondary users.

4. To suggest for NASA's consideration programs or mechanisms to improve the effectiveness and to reduce the cost of NASA's technology transfer program.

5. To maintain awareness of past and ongoing research contributions to understanding the technology transfer process.

6. To maintain contact with sources of technology, with channels of technological communication, and with users of technology, in order to stay in touch with developments and trends affecting performance of these participants in the technology transfer process.

7. Toward the end of the first year's operation, initiate documentation and evaluation of other types of transfer activities resulting from programs such as the RDC activities, the problem-oriented BATeam efforts, COSMIC, or other dissemination efforts.

The balance of the report outlines how the Project for the Analysis of Technology Transfer fulfilled these objectives.

SECTION II. PROGRAM MILESTONES

A synopsis of significant events that occurred during the first year are presented in this section. Many important aspects, not included in the final report, were treated in earlier reports as mentioned below.

Reports

In addition to informal monthly reports, a series of documents reporting PATT research efforts and findings have been published.

Quarterly progress reports were submitted after the third, sixth, and ninth months of performance:

Quarterly Progress Report #1 emphasized administrative and procedural matters, since limited research and data gathering were conducted during the first three months of the project. The primary emphasis was establishing the organization and developing internal systems.

Quarterly Progress Report #2, forwarded in May 1968, emphasized progress made on collection of data, formation of the Transfer Data Bank, and the testing of systems by which data would be stored and analyzed. Three cases describing the use of aerospace developed technology were included.

Quarterly Progress Report #3 included statistical information related to requests for Technical Support Packages (TSP), administrative matters, a statement of PATT library policy and related subject headings, and one transfer case.

Quarterly evaluation reports were published during the fifth, eighth, eleventh, and thirteenth months:

Quarterly Evaluation Report #1 described the Transfer Data Bank in detail. One major PATT task was to design a data handling system suitable for automatic data processing with the capability of indexing, storing, and making available for analyses the information collected on cases of actual or potential transfer. The Transfer Data Bank fulfilled this requirement.

Another report section considered the objectives of the PATT questionnaire, described the results of initial questionnaire test mailing, illustrated the modifications that were incorporated into the final questionnaire format, and stated how the questionnaire results were incorporated into the Transfer Data Bank.

Twenty-two cases describing information usage were included in this report. The cases reported how specific individuals used the Technical Support Packages they had received. These cases were in addition to the twenty-two cases provided to the sponsor in January 1968.

Quarterly Evaluation Report #2 discussed preliminary questionnaire results, presented selected examples of the initial output obtained from the first data run, and described a technique to be used for performing comparative analyses with respect to Technical Support Packages. The report was distributed on July 15, 1968, during the Program Review in Denver.

One hundred twenty-six cases documenting the use and application of selected TSP's were included.

Quarterly Evaluation Report #3, submitted in late October 1968, discussed two major research findings. The first dealt with potential bias built into the Transfer Data Bank resulting from non-response to follow up efforts--it was determined that current procedures produced representative data. The second effort was an analysis of what information seekers were willing to pay for Technical Support Packages.

An instructional outline, prepared by Dr. Walter O. Fischer of the University of Denver's College of Business Administration, was included to assist those who desire to provide instruction about technology transfer and utilization.

Eighty cases were prepared documenting the use and application of Technical Support Packages. A more stringent questionnaire screening process was developed to identify these cases, and the resulting cases produced more significant instances of information use.

Quarterly Evaluation Report #4, to be published in December 1968, will include thirty-six cases describing the use of TSP information.

Special reports were prepared and submitted during the first twelve months. These reports covered areas receiving particular attention, subcontracted research, and professional papers.

An Evaluation of the Responses Indicated on 866 NASA Readership Survey Questionnaires by Robert H. Otten was published on April 30, 1968. The results of a detailed analysis of 866 questionnaires returned by readers of nine Special Publications were presented.

Dr. William H. Clingman, a management and technology consultant, performed two research projects under PATT sponsorship. His first report, titled Study to Evaluate the Indexing of NASA Tech Briefs, was submitted in May 1968. The second report, Methodology for Indexing NASA Tech Briefs - Development and Implementation, was completed in November 1968.

Four additional special studies were completed or initiated. Technology Transfer - A Selected Bibliography by M. Terry Sovel was distributed in November 1968. Second, a case study of a research organization's use and evaluation of a Regional Dissemination Center's services was initiated; it is scheduled for completion in early 1969. Third, assistance was provided to NASA's Office of General Counsel in its annual follow up of individuals or organizations holding NASA patent licenses. And fourth, an inquiry aimed at assisting the BATeams in their transfer documentation is underway.

Two papers were published, both supported in part by PATT. "The Transferability of Aerospace Management Technology," prepared by J. Gordon Milliken and John S. Gilmore, was presented before the American Astronautical Society, Rocky Mountain Section, at its July 15, 1968, meeting in Denver. The October 1968 issue of the Journal of Engineering Education included an article by Browne and Gilmore titled "Technology Transfer and the Universities." Two other papers, one by Milliken and the other by Browne, are being prepared for presentation at the Sixth Space Congress in March 1969.

Internal Panel of Advisors

The Internal Panel of Advisors to PATT, formed early in the project, has developed into an active force encouraging a better understanding of technology transfer on the University of Denver campus. Membership is comprised of: Robert Venuti, Assistant Director of Operations, DRI (Chairman); John S. Gilmore, Senior Research

Economist, Industrial Economics Division, DRI; Don E. Jones, Division Head of Administrative Sciences, College of Business Administration; Charles B. McGee, Associate Professor of Metallurgy and Research Metallurgist; and, Charles Welch, Department of Mass Communications.

Three University of Denver courses have incorporated instruction about technology transfer. An undergraduate College of Business Administration course, Technological Administration, included ten class hours on this subject based on the instructional outline prepared by Dr. Fischer. One Literature of the Sciences class in the Graduate School of Librarianship was devoted to technology transfer. A graduate course in the College of Engineering will be offered in the 1969 Winter Quarter under the title of Engineering Management Information Sources and Retrieval.

SECTION III. STATISTICAL PRESENTATION AND EVALUATION OF COLLECTED DATA

The analysis of questionnaire results presented in this section is based on information stored in the Transfer Data Bank. The bank includes data concerning every questionnaire (see Exhibit I) mailed to individuals who requested a Technical Support Package (TSP).

The total number of cases under analysis was 11,013, which included TSP requests through March 1968. Of these 11,013, 557 requests, or 5.1 percent, did not have a questionnaire mailed to the requestor because of their nature.* Of the remaining 10,456 cases for which questionnaires were mailed, 5,629 completed questionnaires were returned for a 53.8 percent response rate.

In addition to data collection by questionnaire, 292 respondents were selected for interview based upon their questionnaire responses. Brief descriptions were prepared outlining how these individuals used the TSP's. These descriptions will provide additional information about technology transfer once content analysis has been performed.

The following distribution of TSP requests shows the number of requests generated by the NASA and AEC centers.

DISTRIBUTION OF ALL TSP REQUESTS BY PARTICIPATING CENTER

Center	TSP Requests Frequency	Percent	Center	TSP Requests Frequency	Percent
Ames Research Center	1,108	10.1	Manned Spacecraft Center	304	2.8
Argonne National Laboratory	679	6.2	Marshall Space Flight Center	3,210	29.1
Electronics Research Center	72	0.7	NASA Headquarters	12	0.1
Flight Research Center	49	0.4	Space Nuclear Propulsion Office	651	5.9
Goddard Space Flight Center	1,075	9.8	Wallops Station	3	0.0
Jet Propulsion Laboratory	1,010	9.2	Other	7	0.0
Kennedy Space Center	391	3.6	Unknown	17	0.1
Langley Research Center	329	3.0	TOTALS	11,013	100.0
Lewis Research Center	2,096	19.0			

*The bulk of these fell into four categories based on request: (1) Regional Dissemination Centers, (2) NASA Centers, (3) Technology Utilization Offices, and (4) foreign inquiries.

Non-Questionnaire Statistical Presentation*

Even when the questionnaire was not returned, it was possible to code and store a considerable amount of information for each case. The following sections deal with that information obtained from sources other than the returned questionnaire. These data were stored in the Transfer Data Bank.

Standard Industrial Classification (SIC) Codes. Each company or individual requesting a TSP was categorized by Standard Industrial Classification (SIC) code.** The SIC code assigned each requestor of information was the code which designates the primary product of his firm or organization. This procedure was not completely satisfactory. At the two-digit level of the SIC code, desirable results were produced in almost all cases. However, there were cases in which such an assignment to an industry classification could be misleading, e.g., a conglomerate firm active in many product lines. Nevertheless, this information was the only available indicator of the various industries which requested NASA information. If it is borne in mind that the indicators are imperfect, some useful insights can be gained from an analysis of the distribution of TSP requests from the identified industries.

The following table presents the request frequency distribution numerically, and as a percentage of total requests, for the SIC codes from which a significant share of TSP requests originated. The "00" classification is an added code used to indicate that the requestor of the TSP was acting on a personal or individual basis rather than for a firm. A large number of unknown SIC codes was attributable to firms that were not listed in standard reference documents, generally because of their smallness of size or classified nature of their lines of business.

*Detailed data presentations are included in Appendix A.

**The Standard Industrial Classification code is a numerical code prepared by the Technical Committee on Standard Industrial Classification under sponsorship and supervision of the Office of Statistical Standards of the Bureau of the Budget. The SIC code identifies the principal line or lines of business of a given organization. The Dun & Bradstreet market directories provide four digit SIC codes for individual firms, and these were the main sources of SIC codes used in the PATT data collection process.

DISTRIBUTION OF ALL TSP REQUESTS
BY PREDOMINANT STANDARD
INDUSTRIAL CLASSIFICATIONS*

SIC Code	Industry	TSP Requests Frequency	TSP Requests Percent
36	Electrical Machinery	2,264	20.6
82	Educational Services	1,035	9.4
35	Nonelectrical Machinery	857	7.8
28	Chemicals	821	7.5
91	Federal Government	785	7.1
00	Individuals	712	6.5
38	Scientific Instruments	590	5.4
37	Transportation Equipment	556	5.0
89	Miscellaneous Services	339	3.1
	All Others	3,054	27.6
	TOTALS	11,013	100.0

Industries corresponding closely to the six subject area classifications developed by NASA Technical Support Packages were the ones showing greatest interest in Technical Support Packages. The six areas are Electrical (Electronic), Physical Sciences (Energy Sources), Materials (Chemistry), Life Sciences, Mechanical, and Computer Programs.

Another interesting finding was the apparent use that TSP's received in the educational services field. A significant proportion of total requests for information came from this source. NASA and AEC information have been playing an increasing role in the transference of technology through the educational system based on questionnaire responses. In our opinion, emphasis should be intensified in this area since longer range and more lasting benefits are possible.

*A detailed breakdown for all SIC categories is presented in Table A-1.

Subject area. Tech Briefs and Technical Support Packages were categorized into six subject area classifications. As of the end of March 1968, the percentages of published Tech Briefs by category, and the percentage breakdown by information requests were:

PERCENTAGE DISTRIBUTION OF PUBLISHED TECH BRIEFS AND ALL TSP REQUESTS

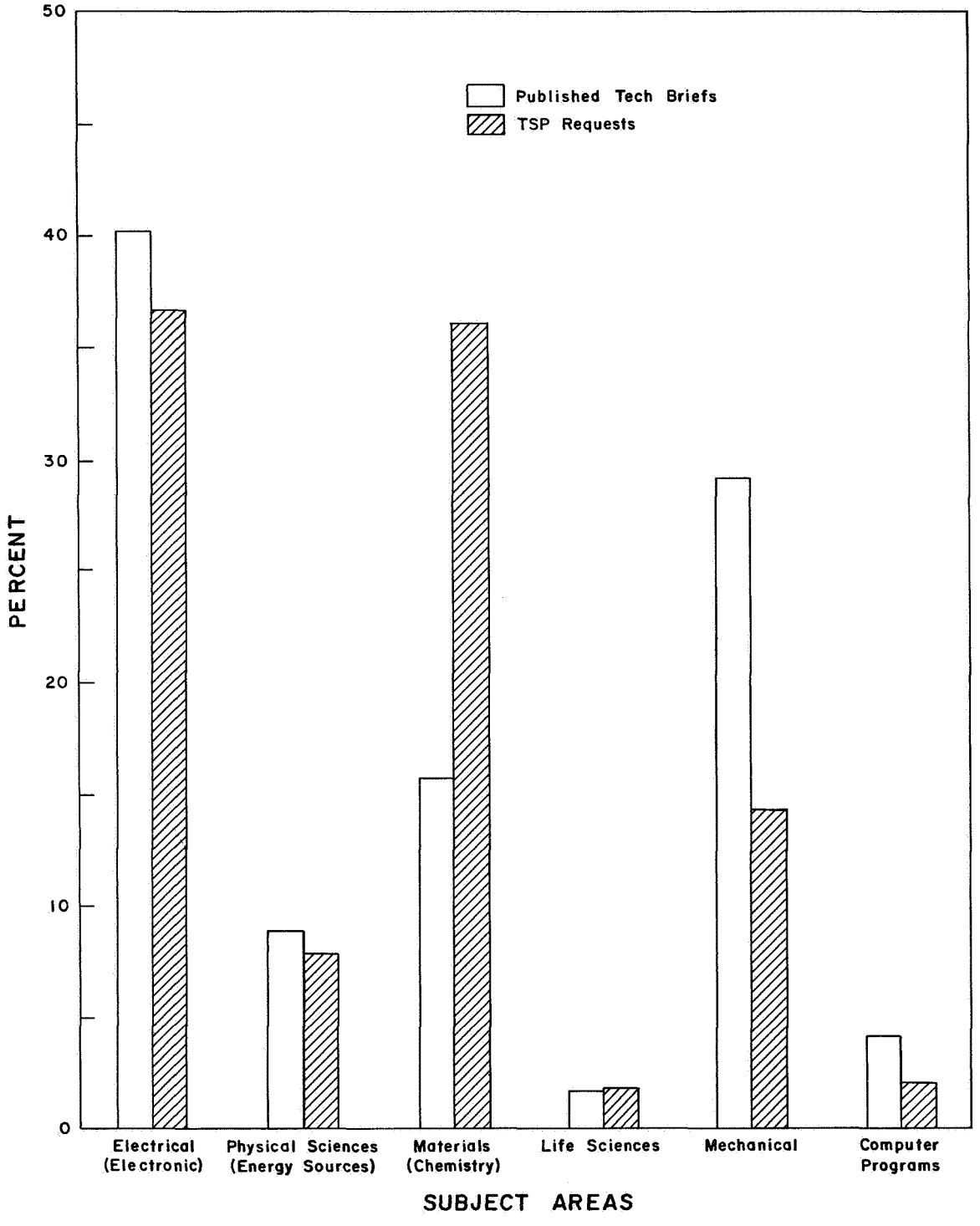
Subject Area	Published Tech Briefs N = 2,092	TSP Requests N = 11,013
Electrical (Electronic)	40.2	37.2
Physical Sciences (Energy Sources)	8.9	7.8
Materials (Chemistry)	15.7	36.2
Life Sciences	1.7	1.8
Mechanical	29.3	14.4
Computer Programs	4.2	2.6
TOTALS	100.0	100.0

Several observations are worth drawing from this distribution. First, the request percentages by subject area are consistent with the percentages for Tech Briefs published in the following areas: (1) Electrical (Electronic), (2) Physical Sciences (Energy Sources), (3) Life Sciences, and (4) Computer Programs. Second, the Materials (Chemistry) field generated more than twice the relative amount of information requests in comparison to its proportion of published Tech Briefs. Third, the Mechanical area generated only half its relative amount of information requests in comparison to its proportion of published Tech Briefs. Figure 1 presents there relationships.

There were several apparent reasons for these variations in the Mechanical area. First, certain Tech Briefs in the Mechanical area appeared to have only narrow technical significance. Second, other Mechanical Tech Briefs were complete in themselves and did not have TSP's. In any event, it appears that a more critical review should be made of Mechanical Tech Briefs prior to publication if their relative impact is to be improved.

A number of insights were obtained from cross tabulation analyses in which the various subject areas were compared with such factors as user company sizes; sources, or channels of awareness; user evaluations

FIGURE 1. PERCENTAGE OF PUBLISHED TECH BRIEFS AND ALL TSP REQUESTS BY SUBJECT AREAS



of the documents; how the users perceived the requested documents with respect to completeness, clarity, and usefulness; and finally the relationship between subject areas and the user's requested disposition of the information obtained from the questionnaire.

There were definite priorities of interest in the various subject areas among companies of differing sizes. The following observations delete the Life Sciences and Computer Programs subject areas because of the limited related data in the Transfer Data Bank.

1. The very small companies, with 1 to 50 employees, and individuals requested subject area information in the following rank order:

Request Rank	Subject Area
1	Mechanical
2	Electrical (Electronic)
3	Materials (Chemistry)
4	Physical Sciences (Energy Sources)

This ranking might be of interest to the Small Business Administration regarding which subject areas should receive the greatest dissemination emphasis.

2. All other sizes of companies were consistent in their priorities of interest among the subject areas. Their ranking of interests was:

Request Rank	Subject Area
1 } tie	Materials (Chemistry)
1 } tie	Electrical (Electronic)
3	Mechanical (a poor third)
4	Physical Sciences (Energy Sources)

3. Subject area interest by company size was:

   a. Electrical (Electronic) - Approximately equal interest to all company sizes.

   b. Physical Sciences (Energy Sources) - In greater demand by the larger companies, although it ranked fourth in both groups.

c. Materials (Chemistry) - In greater demand by large companies than smaller ones.

d. Mechanical - Of most interest to small companies.

When the subject areas were analyzed in conjunction with how an individual became aware of the TSP, the following patterns emerged:

1. NASA channels (Tech Briefs and other NASA publications) were found to be relatively less important in the Electrical (Electronic) area than they were in the case of all information requests. In a reverse fashion, these same NASA channels were relatively more important in the Physical Sciences (Energy Sources) area.

2. The trade press and professional journals were found to generate greater-than-average interest in the Electrical (Electronic) area.

3. Personal contact had its greatest impact in the Electrical (Electronic) area. This was found to be primarily in the biomedical category.

The related data from which the above patterns were developed are shown in Table A-2.

The following was also observed when information users' perceived values of TSP's were cross-tabulated with the subject areas:

1. The major perceived user value for the four subject areas analyzed was that the documents had "increased their knowledge of state-of-the-art."

2. The second most perceived value for all four subject areas was that the documents were "of limited value to their work."

3. In all but the Physical Sciences (Energy Sources) area, the third most perceived value was that the documents were "of great value." The exception noted above received an assigned value of "not applicable" for the third most perceived user evaluation.

4. "Not applicable to my work" was the fourth most perceived evaluation in all areas except the subject area as noted above. The one exception received a rating of "great value" for its fourth most perceived evaluation.

Table A-3 shows the percentage distribution of perceived user values for the four primary subject areas.

A cross tabulation of subject areas and usefulness evaluations resulted in the following ranking:

Rank		Subject Area
1	tie	Electrical (Electronic)
1		Materials (Chemistry)
3		Mechanical
4		Physical Sciences (Energy Sources)

An analysis of the subject areas by the factors of completeness, clarity, and usefulness produced the following (see table below):

1. Materials (Chemistry) - the best with respect to these evaluative factors.

2. Remaining three subject areas - differences between rankings consistently deviated from one another by the same amount.

Subject Area	Completeness Ranking	Clarity Ranking	Usefulness Ranking	Composite (+3=)	Composite Score	Overall Rank
Materials (Chemistry)	1	1	1	3	1.00	1
Electrical (Electronic)	2	3	1	7	2.33	2
Mechanical	4	2	3	9	3.00	3
Physical Sciences (Energy Sources)	3	4	4	11	3.67	4

The subject area associated with respondents who most often requested proprietary treatment of questionnaire information was Materials (Chemistry), in which 16.3 percent of the respondents requested this consideration. Second, with 14.4 percent, was Physical Sciences (Energy

Sources). Third, with 14.1 percent, was Electrical (Electronic); and fourth, with 12.3 percent, was the Mechanical area. Since proprietary treatment was requested in 14.2 percent of all returned questionnaires, those areas deviating most from the average in a positive direction might be indicative of the greater commercial potential contained therein, although the deviations were not large.

Company size. The following tabulations show the request frequencies and percentage breakdowns for total TSP requests through March 1968. Many firms, especially in the smaller size ranges, were not included in the common sources of information, such as the Dun & Bradstreet references. Alternative sources of information were sought with limited success. The large number of unknown company sizes were attributable to this lack of information. It is reasonable to assume that a significant proportion of these unknown sizes were smaller firms.

DISTRIBUTION OF ALL TSP REQUESTS AMONG THE VARIOUS LISTED COMPANY SIZES

Number of Employees	Total TSP Requests Frequency	Percent
1 through 10 (Including Individuals)	749	6.8
11 through 50	29	0.3
51 through 100	81	0.7
101 through 500	587	5.3
501 through 1,000	354	3.2
1,001 through 5,000	979	8.9
5,001 through 10,000	827	7.5
10,001 and up	3,922	35.6
Unknown	3,485	31.7
TOTALS	11,013	100.0

Approximately 95 percent of the requests made for information coming from the smallest size category were made by individuals rather than by firms. Within the designated size ranges, the findings indicate that those making the most frequent requests for NASA and AEC TSP's are individuals and small firms (assuming that many of the unknowns are actually small firms or small organizations).

Location.* Seven states, having in excess of 500 information requests each (California, Illinois, Massachusetts, New Jersey, New York, Ohio, and Pennsylvania) accounted for 59.0 percent of the total requests for supporting information. Of these seven states, California led with 1,727 requests constituting 15.7 percent of the total requests, and New York trailed with 1,223 requests constituting 11.1 percent of the total. Only one state, North Dakota, had no information requests. Approximately two percent of the inquiries were foreign in origin.

The following is a regional distribution of TSP requests which is somewhat similar to domestic industrial concentration patterns.

REGIONAL DISTRIBUTION OF ALL TSP REQUESTS**

Origin	TSP Requests Number	Percent
North East (USA)	3,719	33.8
North Central (USA)	2,952	26.8
West (USA)	2,388	21.7
South (USA)	1,733	15.7
Non-Continental (USA)	14	0.1
Foreign	195	1.8
Unknown	12	0.1
TOTALS	11,013	100.0

*A geographical distribution of TSP requestors is shown in Table A-4. Breakdowns are presented by request frequencies and their corresponding percentages.

**NORTH EAST (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont);

NORTH CENTRAL (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin);

WEST (Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming);

SOUTH (Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia, and District of Columbia);

NON-CONTINENTAL U.S.A. (Alaska, Hawaii, and Puerto Rico);

FOREIGN (Australia, Belgium, Canada, France, Great Britain, Italy, Japan, Sweden, West Germany, Africa-Asia, Latin America, Other Europe).

Inquiry date. The following table shows the bi-annual frequency of requests for Technical Support Packages which are included in the Transfer Data Bank. Frequencies and percentage breakdowns are presented for TSP requests through March 1968.

BI-ANNUAL DISTRIBUTION OF ALL TSP REQUESTS

Periods In Which TSP Requests Were Made	TSP Requests Number	Percent
July 1965 - December 1965	4	0.1
January 1966 - June 1966	66	0.5
July 1966 - December 1966	517	4.6
January 1967 - June 1967	2,410	21.8
July 1967 - December 1967	3,603	32.7
January 1968 - April 1968	4,275	38.8
Unknown	138	1.2
TOTALS	11,013	100.0

Through an experimental process, it was determined that the optimum time lag between the original date of receipt of the TSP inquiry and initiation of the PATT follow up process was approximately six months. Experience indicated that fewer questionnaires were returned by those whose requests were older than six months; in addition, fewer facts were recalled and recorded by the respondent on the returned questionnaire after the six month period. Nevertheless, a longer waiting period might develop more significant circumstances of information application.

Questionnaire Statistical Presentation

Tabulations follow for responses to each of the questions on the follow up questionnaire. Percentages for total inquiries are based on the 5,629 returned questionnaires, representing TSP requests through March 1968.

Question #1. The first question was concerned with how the individual became aware of the availability of Technical Support Packages:

> How did you learn about the availability of the Technical Support Package you requested?

Questionnaire results follow:

Source	TSP Requests Frequency	Percent*
Tech Brief	2,845	50.5
Regular recipient of other NASA publications	446	7.9
Trade press	1,140	20.3
Professional journal	456	8.1
Personal contact	234	4.2
Small Business Administration	70	1.2
State Technical Services	27	0.5
Other	287	5.1
Unknown	124	2.2
TOTALS	5,629	100.0

The primary method (58.4 percent) of learning about available NASA and AEC Technical Support Packages was through Tech Brief announcements and other NASA publications. Second place was attained by the trade press or business press with 20.3 percent. Other sources showed limited impact, but they might represent options for future attention.

*In this and the next table percentages differ slightly from those found in the preceding section titled Subject Area because they are based on straight counts rather than cross tabulation cell counts which delete numbers not contained in both information elements.

Question #2. The second question was designed to obtain a measure of how the requested information contributed to the efforts of the individual or company:

> How would you evaluate the support package which you received? Place (1) by the most appropriate answer and (2) by secondary answer, if any. *

The questionnaire results are:

Information Evaluation	TSP Requests Frequency	Percent
Of no value	183	3.3
Increased my knowledge of state-of-the-art	2,373	42.1
Not applicable to my work	273	4.8
Provided information of limited value to my work	1,793	31.9
Provided information of great value to my work	454	8.1
Resulted in a commercial product or new process	26	0.5
Other	238	4.2
Unknown	289	5.1
TOTALS	5,629	100.0

A favorable response was obtained from 82.6 percent of the questionnaire respondents. However, only 8.6 percent of the respondents (sum of "information of great value to my work" and "resulted in a commercial product or new process") believed that the information that they received was of significant value.

*Only primary answers were coded and analyzed.

Question #3. The information obtained from this question provided an indication of whether or not the situation should be reviewed in the future. If the information suggested a future contact, a follow up date was indicated on the data card for later retrieval. *

The question and answers follow:

> Do you think the information might have use to you or your organization in the future?

Answer	TSP Requests Frequency	Percent
Yes	3,861	68.6
No	1,230	21.8
Unknown	538	9.6
TOTALS	5,629	100.0

The majority responding to this question was optimistic about using the information received at some time in the future.

Question #4 was:

> Approximately how many hours did you and other members of your organization devote to reviewing, studying, or applying the information?

The question had two basic purposes. The first was an attempt to determine the approximate number of hours expended by an individual or his organization in utilizing the NASA or AEC Technical Support Package. The question had a secondary value in helping to identify cases for further

*The tabulations for TSP requests were based upon randomly sampling every twentieth returned questionnaire for those cases having request dates prior to April 1968. These results were then linearly extrapolated for the 5,629 returned questionnaires. This technique was necessary since the coded answers to this question were interpreted as follow up dates rather than as a straight "yes" or "no." The tabulations for the follow up case studies were obtained from an actual count since the total was of a manageable size and did not require a machine count.

follow up action. It was found that, in general, a high number of hours spent in evaluating and using a Technical Support Package was a good indication of possible significant information use.

Data were based on 4,578 returned questionnaires in which respondents completed Question 4. A tabulation of these data is shown on Table A-5.

An analysis of these data indicates a mean evaluation time of 9.4 hours and a median evaluation time of 2.0 hours.

Cross tabulations were made of mean and median evaluation time with eight other factors. In general, these correlations produced information of limited significance.

Comparison of mean evaluation time with "Information Evaluation" ratings (Question 2) and "Information Usefulness" ratings (Question 5) indicates that evaluation time generally varies directly with these two factors; the better the perceived usefulness or evaluation for the TSP, the greater the mean number of hours used in TSP evaluation and utilization. These conclusions reinforce the use of high evaluation times as an indicator of need for further case follow up action.

Implications for economic evaluation. As mentioned above, the mean evaluation time resulting from the 4,578 responses was 9.4 hours. If it is assumed that the universe of Technical Support Package users is equivalent in nature to the respondents, the following conclusion would be possible: A mean time of 9.4 manhours was expended by users in the utilization of information contained in each Technical Support Package which NASA and AEC distributed.

In the first four months of 1968, NASA and participating AEC centers received approximately 5,700 Technical Support Package requests. The implication then, assuming that each of these requests was answered with a Technical Support Package, is that the users have expended 53,580 manhours ($5,700 \times 9.4$) in evaluating and utilizing Technical Support Package information during the first four months of 1968. Linear extrapolation of these figures on an annual basis results in a total expenditure by users of approximately 161,000 manhours during calendar year 1968. It is tenuous to estimate what exact value to place on these manhours; however, a figure of $10 per manhour including overhead would be conservative. If this approach is reasonable, a total 1968 expenditure of $1,610,000 was involved in using Technical Support Packages.

Question #5. A system was developed to weigh the relative value of Technical Support Package based upon the respondents' answers to Question Five. Question Five read:

> How would you rate the information you received in the following factors?
>
> Completeness Clarity Usefulness

The respondent was asked to rate each of these factors against the standards of "excellent," "good," "fair," and "poor." Values were assigned each rating: excellent = one, good = two, fair = three, and poor = four.*

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*The formula involved in this system was:

$$R_i = \frac{n_1(1) + n_2(2) + n_3(3) + n_4(4)}{N}$$

where:

$R_i = R_{completeness}$, $R_{clarity}$, $R_{usefulness}$

N = total valid respondents

n_v = number of responses of each value

v = response value

A relative weighted mean for each factor was possible from a high of 1.00 to a low of 4.00. An example of this formula is provided below for Tech Brief B64-10171 for the completeness factor.

$$R_{completeness} = \frac{57(1) + 47(2) + 3(14) + 4(2)}{120} = \frac{201}{120} = 1.68$$

Another application was to expand the computations to aggregate form by computing the relative weighted means for documents in the system in total and by center of origin. This provided for comparisons beyond the single document to comparisons among centers or the total system. The significance one might attach to any relative weighted mean (R_i) increases as the respondent population (N) used in the computation process increases. Thus, comparison of factors related to various Technical Support Packages must be made with an awareness of respondent population size. Care must be taken not to overemphasize weighted means based upon small respondent populations.

Tech Brief relative weighted means were determined through the use of responses made by questionnaire respondents who requested Technical Support Packages prior to April 1968. Tech Briefs (titles are included in Appendix B) with a questionnaire response level (N) of 50 or more are presented in Table A-6.

The following weighted mean ranges were observed for the three factors for those Technical Support Packages with "N's" equal to or greater than 50:

Factors	Relative Weighted Mean Ranges
Completeness	1.56 to 2.54
Clarity	1.56 to 2.18
Usefulness	1.81 to 2.64

The transfer mechanism (NASA or participating AEC center) was another area for which a relative weighted mean can be determined. In computing the relative weighted mean of a given transfer mechanism, all evaluations related to Technical Support Packages prepared within the given mechanism were included. The following data were prepared based upon aggregated responses from those who completed questionnaires on Technical Support Packages requested prior to April 1968. Attention must be given to the size of the respondent population (N) in order to better judge the significance of these ratings. It is also necessary to recognize that one or two high demand TSP's might greatly influence individual center figures.

Transfer Mechanism	N	$R_{completeness}$	$R_{clarity}$	$R_{usefulness}$
Ames Research Center	555	1.78	1.70	2.08
Argonne National Laboratory	271	2.16	1.91	2.38
Goddard Space Flight Center	539	2.17	1.90	2.41
Jet Propulsion Laboratories	438	2.07	1.90	2.47
Kennedy Spacecraft Center	189	1.97	1.88	2.25

Transfer Mechanism	N	$R_{completeness}$	$R_{clarity}$	$R_{usefulness}$
Langley Research Center	152	1.81	1.85	2.20
Lewis Research Center	874	2.15	1.85	2.44
Manned Spacecraft Center	145	1.97	1.95	2.43
Marshall Space Flight Center	1,516	1.92	1.90	2.21
Space Nuclear Propulsion Center	294	1.90	1.82	2.22

Only transfer mechanisms with an "N" in excess of 100 were considered in the above table.

The relative weighted mean ranges for those transfer mechanisms shown above were:

Factor	Weighted Mean Range
Completeness	1.78 to 2.17
Clarity	1.70 to 1.95
Usefulness	2.08 to 2.47

The following data represent the aggregate totals of responses by relative factors for TSP requests initiated prior to April 1968. Blanks do not affect the calculation and were therefore deleted from the presentation. The tabulations and weighted means are:

	Completeness		Clarity		Usefulness	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Excellent	1,235	24.5	1,425	28.4	807	16.6
Good	2,783	55.2	2,944	58.8	2,215	45.7
Fair	831	16.5	558	11.1	1,417	29.2
Poor	190	3.8	85	1.7	412	8.5
TOTALS	5,039	100.0	5,012	100.0	4,851	100.0

RELATIVE WEIGHTED MEANS FOR ALL TSP REQUESTS

	N	$R_{completeness}$	$R_{clarity}$	$R_{usefulness}$
System Aggregate	4,962	2.00	1.86	2.30

These weighted means do not necessarily reflect the operating standards against which the transfer mechanisms and Technical Support Packages should be compared. Ideally, the operating standards should be based on more favorably weighted means found toward the upper end of the evaluation spectrum.

There were obvious differences among the Technical Support Packages and the transfer mechanisms. It was evident that the Technical Support Packages which stimulated the greatest interest have, for the most part, higher (numerically lower due to the inverse value system employed) respondent evaluations than for the aggregate factor evaluations present for the originating transfer mechanisms. It follows that the better the Technical Support Package is in terms of completeness, clarity, and usefulness, the greater the probability is that it will generate a high demand.

Two possible developments might cause demand to become more even among Technical Support Packages and encourage a reduction in the range size for each evaluation factor. One possible change is a standard Clearinghouse charge for TSP's being enacted, and the other is the possibility of controls being incorporated to better screen and upgrade TSP's. In any event, emphasis should be placed on the continual upgrading of Technical Support Packages if they are to continue to be used by technical information seekers.

Question #6. It is very important when dealing with industrial and commercial firms that respect be given to possible desires of industry to designate a returned questionnaire as being confidential or proprietary. Question Six of the follow up questionnaire dealt with this problem by differentiating between proprietary information and information available for open distribution. The Question and the results are:

> Are any of the above responses to be considered proprietary information? If yes is checked, no information will be identified with you or your firm.

Clearance	TSP Requests Frequency	Percent
Yes	797	14.2
No	4,632	82.3
Blanks	200	3.5
TOTALS	5,629	100.0

A substantial majority of the respondents placed no restriction on the use of the returned questionnaire information. Even among those cases singled out as having higher potential for further analysis, there was only a slight increase in the proprietary designation. The candor of questionnaire respondents aided in the development of a useful information base.

SECTION IV. ANALYSIS OF CHARACTERISTICS OF 89 SELECTED TSP'S

Prior to April 1968, 2,092 Tech Briefs had been published. Requests for related Technical Support Packages (TSP's) processed through March 1968, numbered 11,013. However, many TSP's had been prepared for which there had been no requests. Of the 2,092 Tech Briefs published, 902 stimulated requests for support documents since mid-1965, and of these, 732 were requested by five or fewer persons. A total of 89 were requested at least 25 times. Since it was impractical to analyze data on all the documents published, many of which were requested by only one or two persons, the 89 TSP's which were requested at least 25 times were selected for special analysis since they stimulated the highest demand. The findings are discussed in this section.

For convenience, and to provide another focus, the 89 documents were grouped into six classifications. The six groups and the types of documents included in each are:

Group Designation	Includes
Manuals	Manuals, handbooks, literature reviews, compilations, special studies, new designs, results of test programs.
Materials	New materials, such as alloys or chemicals, or new uses of existing materials.
Biomedical	Equipment and techniques for biomedical measurements, telemetry, and the like.
Electronics	Components, circuits, subsystems, or complete systems not specifically intended for testing and measurement functions.
Testing	Testing techniques, measuring tools, test equipment, instruments, gauges not used for biomedical research.
Management	Computerized techniques for management.

These classifications were considered to be more useful for analytical purposes than was the six subject system used by NASA for indexing purposes. For example, the inventions grouped here under the Biomedical heading were classified variously in the Cumulative Index to NASA Tech Briefs under "Electrical (Electronics)," and "Life Sciences." The TSP's classified here under the Manuals heading were found throughout four of the six NASA subject areas, but follow up interviews indicate that these types of documents tend to be used as reference works. Therefore, these groupings provided a better base for the following analysis. The results of the data analysis using this different approach are consistent with the preceding section, and provide additional insights.

A list of the documents and their titles, by category, is in Appendix B.

Awareness Sources of the 89 Selected TSP's

NASA. About 59 percent of the 3,612 persons who indicated the source from which they derived awareness of the requested TSP's stated that Tech Briefs or regular NASA subscriptions accounted for their awareness. Two groups were significantly more dependent on these NASA channels for awareness of TSP's: those who ordered materials in the Manuals category and those who were interested in the Management TSP's. Over three-fourths of all those who requested information in these two areas became aware of the information through NASA channels. On the other hand, NASA channels were relatively least important for awareness of Biomedical and Materials TSP's.

Industry media. More than one-third of the requests for TSP's resulted from notices and articles in either business press publications or professional journals. A significantly greater proportion of awareness stemming from these industry media occurred in the case of TSP's about Materials. Significantly smaller proportions of requestors became aware of information in the area of Manuals and Management through these sources.

Personal contact. Less than five percent of all orders resulted from personal contact, except in the case of Biomedical devices. The high proportion (18 percent) of personal-contact awareness with respect to Biomedical devices was a reflection of the information acquisition habits of the medical electronics industry and medical researchers. The

medical electronics industry is young and fragmented, with few well-developed formal information channels.

SBA and OSTS. Less than one percent of the respondents indicated that either the Small Business Administration (SBA) or the Office of State Technical Services (OSTS) accounted for their awareness of requested TSP's. However, SBA only initiated intensive efforts in information dissemination in April 1968; the proportion of information recipients who derive awareness of NASA technology through the services of the SBA should increase in the future. For example, over 1,000 requests, about 15 percent of the total, originated from SBA offices during the April-September 1968 period. No evidence yet exists to indicate a change in the OSTS impact. Greater awareness and use of TSP's might be possible by emphasizing publicity concerning TSP's in those information channels which appear to have been relatively less important.

It appears especially appropriate to emphasize business press channels for documents having the character of reference works and those which describe materials inventions. Even though industry media were prominent as awareness sources for biomedical TSP's, the relatively large awareness through personal contact suggests that greater use of press releases or articles in medical and electronics journals would increase awareness of these inventions.

The distribution of sources of awareness of TSP's by category is:

SOURCE OF AWARENESS OF 89 MOST FREQUENTLY REQUESTED TSP'S

(Percentages)

	NASA	Industry Media	Personal Contact	SBA	OSTS	Totals
Manuals	80.2	16.0	3.0	0.3	0.5	100.0
Materials	44.2	50.7	3.5	1.0	0.6	100.0
Biomedical	40.8	41.0	17.9	0.2	0.2	100.1
Electronics	54.9	40.7	2.9	0.6	0.8	99.9
Testing	56.1	40.1	3.0	0.3	0.6	100.1
Management	75.3	22.5	2.2	0.0	0.0	100.0
Aggregate Proportions	59.0	34.8	5.2	0.5	0.5	100.0

Organization Size

Organization size was determined for more than 5,000 cases. The larger organizations (those with more than 5,000 employees) accounted for about two-fifths of all requests, medium-size firms (501-5,000 employees) for about one-eighth, and small firms (those for which size was not known and those with 11-500 employees for slightly more than one-third. The remaining six percent was accounted for by those in size class 1 (1-10 employees), of which 95 percent were individuals who did not state an organizational affiliation. This group was assumed to be comprised entirely of individuals.

Deviations from the overall proportions, which might indicate differential preferences relative to organization size, are discussed in the succeeding sections. The supporting data are:

SIZE DISTRIBUTION OF ORGANIZATIONS WHICH REQUESTED THE 89 MOST FREQUENTLY REQUESTED TSP'S

(Percentages)

	Individuals	Small Size Unknown	Small 11-500 Employees	Medium 501-5,000 Employees	Large 5,000 and More Employees	Totals
Manuals	9.1	24.9	6.1	12.3	47.0	100.1
Materials	3.5	35.5	6.4	12.2	42.4	100.0
Biomedical	4.8	42.3	2.9	9.9	40.1	100.0
Electronics	4.8	30.7	9.2	12.9	42.4	100.0
Testing	6.0	30.7	5.0	15.1	43.1	99.9
Management	2.4	23.5	8.0	16.8	49.2	99.9
Aggregate Proportions	6.0	31.4	6.1	12.5	43.9	99.9

Individuals. The only relatively large deviations from the overall average were in the Manuals and Management areas. Individuals appeared to be slightly more interested in Manuals and slightly less interested in Management technology.

Small organizations. Similarly small firms were relatively less important as consumers of information relating to Manuals and Management. The finding of the previous section dealing with sources of awareness--that both of these areas were dominated by NASA

channels as the stimulant of interest--suggested an explanation for the lesser importance of small organizations in these areas. It is highly probable that small firms have been less aware of the variety of information available from NASA. Also, the lesser importance of Management TSP's to small firms might reflect the expense and relative unavailability of computer services for small firms. In addition, the sophistication of these techniques was probably beyond their usual requirements.

A slightly greater-than-average interest in the area of Biomedical devices was displayed by small organizations. Biomedical research is conducted in hospitals and medical schools which often have relatively small staffs, and many medical electronics firms are quite small.

Medium-size organizations. Firms with 501-5,000 employees accounted for about one-eighth of all requests. They were relatively more important as users of Management and Testing TSP's. This was offset by a small negative disproportion in the Biomedical area.

Large organizations. The predominance of large organizations as users of information concerning Manuals and Management was the mirror image of the small usage of these documents by small companies. The explanation for the large-firm dominance in these areas is the converse of that given for the small representation of small companies: large firms were more likely to be cognizant of NASA information availability, and also more likely to have the resources and computer accessibility required to apply the sophisticated management technology.

With respect to fostering increased use of TSP's among firms of various sizes, it is significant that the smallest firms are presently important users of TSP's. However, there may be considerable opportunity to diffuse more information to smaller firms. The importance of exploring opportunities to spread technology to firms with fewer than 500 employees is indicated by the facts that such firms constitute about 99 percent of all business firms in the nation and account for nearly three-fourths of the nation's employment. Yet, smaller firms accounted for only 40 percent of TSP requests. While it is undoubtedly true that TSP's would have limited or no value to many small firms (e.g., barber shops and gift shops), this appears to be an area deserving of further attention.

Industry Classification

Forty-one industry groups generated at least five requests each. The cross tabulation by category of the number of requests from each of these industries is presented in Table A-7. Detailed distributions are included in Table A-8. The largest number of information requests from the private sector came from the Electrical Machinery industry (SIC 36), which accounted for 1,500 requests. Educational Services (SIC 82) accounted for 737 requests, followed by Chemicals and Allied Products (SIC 28) with 599 requests, and Nonelectrical Machinery (SIC 35), 585 requests. Individuals who did not specify an organizational affiliation placed 419 orders.

Within these high-interest industries several patterns of interest emerge.

- The Electrical Machinery group was most interested in Manuals, Materials, and Electronics TSP's.
- Educational Services' inquiries were dominated by interest of biomedical innovations. This reflected the research efforts of medical schools in large part. Other types of documents popular with this industry were in the Manuals and Materials areas. (While the data presented here do not reflect it, many of these documents are being used by university faculty members as reference material for course lectures. Examples can be found in the case studies presented in the Quarterly Evaluation Reports.)
- The main focus of interest in the Chemicals industry was in the Materials TSP's.
- The remaining industries' requests were each predominantly for Manuals.

Demand for TSP's in the area of Materials was greatest from the Chemicals industry, but Nonelectrical Machinery accounted for nearly as many. Other high-interest industry groups included Educational Services, Transportation Equipment, and Nonelectrical Machinery.

Biomedical devices were of greatest interest to the Educational Services industry which includes medical schools. Significant interest was also shown by Medical and Other Health Services, Electrical Machinery, and Professional and Scientific Instruments industries.

As might be expected, the Electrical Machinery industry dominated the Electronics requests. Nonelectrical Machinery followed, and Educational Services and Transportation Equipment firms were important users.

The same industries accounted for the bulk of requests for Testing information, except for the displacement of Educational Services by the Instruments manufacturing industries. By industry group, requests for Testing documents were greatest in the following industries: Electrical Machinery, Nonelectrical Machinery, Professional and Scientific Instruments, and Transportation Equipment.

Management technology was most popular with the Electrical Machinery industry. Relatively great interest was also shown by the Nonelectrical Machinery, Instruments, and Miscellaneous Services industries, although overall interest was low.

The preceding paragraphs have dealt with requests from industry groups which are exclusively or largely in the private sector. Nevertheless, Federal Government agencies were prominent as users of information in each category. These agencies requested a total of 541 TSP's concerning the 89 selected NASA and AEC Tech Briefs, thereby constituting significant consumers. In addition, many of the requests from Educational Services and Medical and Other Health Services were from public-sector agencies. The diffusion of technology within the public sector obviously can have great importance, and its value should be recognized.

State and local governments were minimal users of Technical Support Packages. There appear to be significant opportunities for stimulating demand in these areas, especially in the Management category.

A balanced evaluation of the transfer of technology from NASA to the private sector should recognize that many industry groups have not used TSP's in great proportions. Seven industry groups and the Individuals group accounted for 74 percent of the requests for the documents in this selected group. However, comparing the proportions of TSP's requested by the various industry groups with the proportion of annual research and development funds in the various industries suggests that the TU program has been diffusing technology beyond the industries spending large amounts for Research and Development. The related data are:

COMPARISON OF PROPORTIONS OF THE 89 MOST FREQUENTLY REQUESTED TSP'S REQUESTED FROM INDUSTRY GROUPS WITH PROPORTIONS OF R&D FUNDS SPENT BY INDUSTRY IN 1966

(Percentages)

	R&D Funds*		TSP Requests**
Aircraft and missiles	35.0	43.5	7.2
Transportation equipment	8.5		
Electrical equipment and communication	23.0		26.8
Chemicals	9.7		10.7
Machinery	8.4		10.4
Professional and scientific instruments	2.9		6.4
Petroleum refining and extracting	2.8		1.2
Primary metals	1.5		3.1
Rubber products	1.2		2.0
Fabricated metals	1.1		3.0
Food and kindred products	1.1		0.2
Stone, clay and glass products	0.8		2.0
Paper	0.5		0.5
Textiles and apparel	0.3		0.7
Lumber, wood products, and furniture	0.1		0.7
All other industries	3.1		25.1***
TOTALS	100.0		100.0

*Source: U.S. Bureau of the Census, Statistical Abstract of the United States: 1968, 89th Edition (Washington: Government Printing Office, 1968), p. 527.

**Source: Table A-8.

*** "All other industries" includes Individuals, but excludes Educational Services, Federal, State, and Local Governments.

The small proportion of TSP's which were ordered by firms in the Transportation Equipment industry, which included the Aircraft group was notable. The 7.2 percent also included 20 requests from the Ordnance and Accessories group. R&D spending in these two industries accounted for 44 percent of all R&D performed by industry in 1966; yet, firms in these industries accounted for only 7 percent of all TSP requests in this selected group. The difference was balanced out at the bottom of the list--the "Other" category which includes all industries not listed.

The 1,412 requests comprising the remaining 25 percent (All Other Industries) were rather thinly spread among a large number of industries, but the evidence nevertheless suggested that the TU program has been enhancing the diffusion of NASA's R&D to industries that are technology-poor when judged by the standard of R&D spending.

The foregoing discussion should not be taken as an indication that the firms and industries engaged in aerospace R&D were not utilizing the TU program. Even though the Aircraft and Missiles industry accounted for a relatively small proportion of TSP requests, it is highly probable that firms in this industry have access to certain TSP information independently of the Technology Utilization Division dissemination program. Access is on the input side of the TU program.

Aerospace firms are quite important as generators of the innovations which the TU program disseminates. For example, the Cumulative Index to NASA Tech Briefs, 1963-1967 shows that over half the listed inventions came from contractors. Of the 2,015 listed inventions, more than 500 originated with six aerospace contractors: North American Rockwell, Boeing, General Dynamics, Aerojet General, Lockheed, and the former Douglas organization.

Intra-firm information distribution within these and other aerospace companies has probably disseminated information contained in TSP's and thereby affected the demand for additional information. The impact of this situation is unknown.

Based upon our observations, it appears that considerable untapped demand is present in various industries for TSP's. A lack of awareness might be one major reason for this situation. It might be productive to select specific TSP's of possible interest to those industries, and make a special attempt to advise the appropriate journals or business press serving the industries of the availability of the selected TSP's.

Industries which appear suitable for this special attention include, for instance, mining, food products, apparel, construction, and air transportation.

State and local government agencies, in particular, deserve greater attention. These agencies do not have needs and interests that coincide with all the technology generated by NASA or AEC, but there appears to be a significant gap between possible and actual usage of TSP's. The large volume of requests from federal agencies suggests that some TSP's are germane to government problems. Limited use of these TSP's by state and local government might be related to a lack of awareness.

Information Evaluation

The distribution of questionnaire responses regarding the users' evaluations of TSP's is presented below.

INFORMATION EVALUATIONS FOR THE 89 MOST FREQUENTLY REQUESTED TSP'S

(Percentages)

	No Value or Not Applicable	Increased State-of-the-Art	Limited or Great Value	New Product or Process	Totals
Manuals	5.2	45.2	49.5	0.1	100.0
Materials	11.2	51.6	36.0	1.2	100.0
Biomedical	4.9	47.4	47.2	0.4	99.9
Electronics	9.2	44.3	46.0	0.4	99.9
Testing	7.9	49.4	42.5	0.3	100.1
Management	10.2	40.7	48.5	0.6	100.0
Aggregate Proportions	7.8	47.3	44.4	0.5	100.0

In general, about one-twelfth of the selected TSP's were judged by users to be of no value or not applicable to their work. Nearly half were reported to have advanced the user's state-of-the-art knowledge. About 44 percent were of some value to the respondent's work, and less than one percent resulted in a new product or process. Extreme departures from this pattern did not occur, but the few somewhat noticeable deviations are discussed below.

Of no value or not applicable. Slightly higher-than-average proportions of documents in the Materials and Management areas were so characterized, but relatively fewer Biomedical devices were negatively rated.

Advanced state-of-the-art knowledge. A less-than-average proportion appeared in the area of Management technology, and a greater-than-average proportion of such evaluations were given the Materials TSP's.

Of limited or great value to work. Materials TSP's were below average in this rating, and Manuals were above average.

New product or process. Materials information dominated this category. Eleven of the eighteen answers of this type were in the Materials category, six for the Goddard inorganic paint TSP (65-10156) and five for the thermosetting plastic (67-10197) developed by TRW Systems.

Transfer Mechanisms Involved with Selected TSP's

Origins of TSP's requested at least 25 times are presented in Table A-9. This cross tabulation shows that Marshall Space Flight Center was responsible for the largest number of documents (25), followed by Ames Research Center (15) and Lewis Research Center (15). By category, Marshall and Ames stood out: Ames produced 8 of the 12 biomedical documents, and Marshall developed 15 of the 24 manuals. Lewis Research Center's output was more evenly spread across the categories.

Table A-10 deals with the number of orders in each category by center. On this basis, Marshall Space Flight Center received the most requests. The 2,043 requests directed to Marshall constituted 27 percent of all TSP orders in this selected group of TSP's. Lewis Research Center was in second position; its 1,605 orders accounted for 21 percent of all orders in the group. The most popular category at Lewis was the Materials documents while Manuals were dominant at Marshall. Finally, Ames Research Center received 1,298 (17 percent) of the orders in the group, with the largest proportion in the Biomedical area.

Comparisons among transfer mechanisms relative to the number of requests should be made with recognition of the possible influence of

a single TSP. For example, about half of the total requests directed to SNPO, Lewis, and Goddard were for a single TSP. This indicates that one or two very popular TSP's might distort the significance of data on total requests.

APPENDICES

There are two parts to this section:

Appendix A includes detailed data tabulations related to discussions presented earlier in this report.

Appendix B lists, by title and number, the Tech Briefs which stimulated the greatest demand for related Technical Support Packages. The listing is divided into six categories.

TABLE A-1. DISTRIBUTION OF ALL TSP REQUESTS BY STANDARD INDUSTRIAL CLASSIFICATIONS

SIC Code	Industry	TSP Requests	
		Frequency	Percent
00	Individual	712	6.5
01	Agricultural Production	2	0.0
07	Agricultural Services	2	0.0
09	Fisheries	1	0.0
10	Metal Mining	23	0.2
12	Bituminous Coal and Lignite Mining	8	0.1
13	Crude Petroleum and Natural Gas	49	0.4
14	Mining, Non-Metallic Minerals	5	0.0
15	General Building, Manufacturing	14	0.1
16	Other Construction	8	0.1
17	Construction	7	0.1
19	Ordnance and Accessories	22	0.2
20	Food Products	16	0.1
21	Tobacco	3	0.0
22	Textiles	43	0.4
23	Apparel, Fabric Products	11	0.1
24	Lumber and Wood Products	45	0.4
25	Furniture	22	0.2
26	Paper Products	50	0.5
27	Printing	84	0.8
28	Chemicals	821	7.5
29	Petroleum Refining	51	0.5
30	Rubber, Plastics	148	1.3
31	Leather and Leather Products	4	0.0
32	Stone, Clay and Glass Products	169	1.5
33	Primary Metals	259	2.4
34	Fabricated Metals	258	2.3
35	Nonelectrical Machinery	857	7.8
36	Electrical Machinery	2,264	20.6
37	Transportation Equipment	556	5.0
38	Scientific Instruments	590	5.4
39	Miscellaneous Manufacturing	135	1.2
40	Railroad Transportation	6	0.1
41	Highway Passenger Transportation	1	0.0
44	Water Transportation	8	0.1
45	Air Transportation	22	0.2
46	Pipeline Transportation	10	0.1

TABLE A-1. (Continued)

SIC Code	Industry	TSP Requests Frequency	Percent
47	Transportation Services	2	0.0
48	Communications	18	0.2
49	Electricity, Gas, Sanitary Service	23	0.2
50	Wholesale Trade	141	1.3
52	Building Materials, Hardware, Farm Equipment	5	0.0
53	Retail Trade, General Merchandise	1	0.0
55	Auto Dealers, Gas Service Stations	14	0.1
57	Furniture and Furniture Stores	3	0.0
59	Miscellaneous Retail	4	0.0
60	Banking	1	0.0
61	Other Credit Agencies	1	0.0
62	Brokers, Securities	3	0.0
67	Holding, Investment Companies	33	0.3
70	Hotels and Other Lodging Places	1	0.0
72	Personal Services	21	0.2
73	Miscellaneous Business Services	300	2.7
76	Miscellaneous Repair Services	1	0.0
80	Medical, Health Services	195	1.8
81	Legal Services	3	0.0
82	Educational Services	1,035	9.4
84	Museums, Art Galleries, Zoological Gardens	4	0.0
86	Nonprofit Membership Organizations	4	0.0
89	Miscellaneous Services	339	3.1
91	Federal Government	785	7.1
92	State Government	47	0.4
93	Local Government	5	0.0
94	International Government	6	0.1
	Unknown	732	6.6
	TOTALS	11,013	99.7

TABLE A-2. PERCENTAGE DISTRIBUTION OF ALL TSP REQUESTS BY SUBJECT AREA AMONG VARIOUS CHANNELS OF AWARENESS

Subject Area	Tech Briefs (%)	Other NASA Publications (%)	Business Press (%)	Professional Journals (%)	Personal Contact (%)
Electrical (Electronic)	51.9	6.3	24.3	8.6	6.5
Physical Sciences (Energy Sources)	60.7	8.6	17.3	9.4	2.5
Materials (Chemistry)	56.0	10.0	22.4	7.7	2.8
Mechanical	54.3	11.5	17.3	11.1	3.5
Others	55.4	7.6	18.3	10.8	6.8
WEIGHTED MEAN	54.5	8.6	21.8	8.7	4.5

TABLE A-3. PERCENTAGE DISTRIBUTION OF INFORMATION EVALUATIONS BY SUBJECT AREA RESULTING FROM RETURNED QUESTIONNAIRES

	Percent of Questionnaire Responses by Subject Area			
Information Evaluations	Electrical (Electronics)	Physical Sciences (Energy Sources)	Materials (Chemistry)	Mechanical
"Increased my knowledge of state-of-the-art"	44.1	49.2	49.6	43.7
"Provided information of limited value to my work"	36.1	34.1	32.9	37.1
"Provided information of great value to my work"	10.6	4.4	8.7	8.0
"Not applicable to my work"	5.0	7.3	5.1	6.6
Other than those listed	4.2	5.0	3.7	4.6
TOTALS	100.0	100.0	100.0	100.0

TABLE A-4. GEOGRAPHICAL DISTRIBUTION OF ALL TSP REQUESTS

Location	TSP Requests Frequency	TSP Requests Percent	Location	TSP Requests Frequency	TSP Requests Percent
Washington, D.C.	117	1.1	New York	1,223	11.1
Alabama	81	0.7	North Carolina	67	0.6
Alaska	5	0.0	Ohio	821	7.5
Arizona	81	0.7	Oklahoma	78	0.7
Arkansas	9	0.1	Oregon	55	0.5
California	1,727	15.7	Pennsylvania	906	8.2
Colorado	131	1.2	Rhode Island	45	0.4
Connecticut	319	2.9	South Carolina	36	0.3
Delaware	34	0.3	South Dakota	15	0.1
Florida	161	1.5	Tennessee	98	0.9
Georgia	57	0.5	Texas	392	3.6
Hawaii	9	0.1	Utah	49	0.4
Idaho	25	0.2	Vermont	13	0.1
Illinois	678	6.2	Virginia	144	1.3
Indiana	306	2.8	Washington	178	1.6
Iowa	48	0.4	West Virginia	36	0.3
Kansas	59	0.5	Wisconsin	299	2.7
Kentucky	57	0.5	Wyoming	2	0.0
Louisiana	75	0.7	Australia	3	0.0
Maine	20	0.2	Belgium	3	0.0
Maryland	279	2.5	Canada	50	0.5
Massachusetts	562	5.1	France	5	0.0
Michigan	376	3.4	Great Britain	89	0.8
Minnesota	150	1.4	Italy	1	0.0
Missouri	181	1.6	Japan	7	0.1
Mississippi	12	0.1	Sweden	3	0.0
Montana	18	0.2	West Germany	6	0.1
Nebraska	19	0.2	Africa-Asia	16	0.1
Nevada	12	0.1	Latin America	2	0.0
New Hampshire	60	0.5	Other Europe	10	0.1
New Jersey	571	5.2	Unknown Origin	12	0.1
New Mexico	110	1.0	TOTALS	11,013	99.6*

* Due to rounding.

TABLE A-5. DISTRIBUTION OF EVALUATION TIMES CONSUMED IN EVALUATING AND USING INFORMATION CONTAINED IN ALL TSP'S AS OBTAINED FROM RESPONSES TO QUESTION 4 OF THE QUESTIONNAIRE

Evaluation Time (Hours)	Frequency of Response	Evaluation Time (Hours)	Frequency of Response
0.0	59	23.0	2
0.1	63	24.0	29
0.2	57	25.0	13
0.3	96	26.0	1
0.4	19	28.0	2
0.5	374	30.0	11
0.6	3	32.0	6
0.7	15	33.3	1
0.8	8	34.0	1
0.9	1	35.0	7
1.0	969	36.0	3
1.1	2	37.0	1
1.3	1	38.0	1
1.5	97	40.0	58
2.0	820	42.0	1
2.3	1	45.0	5
2.5	79	48.0	2
3.0	301	50.0	22
3.5	42	55.0	1
4.0	357	60.0	11
4.5	20	65.0	1
5.0	136	70.0	1
5.5	10	72.0	1
6.0	123	75.0	2
7.0	23	80.0	12
7.5	2	90.0	1
8.0	183	100.0	41
8.5	2	102.0	1
9.0	12	120.0	5
10.0	180	150.0	1
10.1	1	160.0	4
11.0	12	200.0	10
11.5	2	202.2	1
12.0	49	240.0	4
12.5	3	250.0	2
13.0	4	300.0	2
14.0	2	320.0	1
15.0	20	356.0	1
16.0	38	540.0	1
17.0	4	732.8	1
17.6	1	750.0	1
18.0	4	800.0	1
20.0	96	999.9	7
21.0	3		
22.0	4	TOTAL	4,578

TABLE A-6. RELATIVE WEIGHTED MEANS FOR DOCUMENTS HAVING A QUESTIONNAIRE RESPONSE LEVEL (N) OF 50 OR MORE

Document Number	Originating Center	N	Completeness	Clarity	Usefulness
B64-10171	Ames	120	1.68	1.65	1.99
B65-10156	Goddard	170	1.92	1.81	2.26
B65-10203	Ames	71	1.56	1.56	1.81
B66-10057	Ames	85	1.78	1.70	1.89
B66-10449	Marshall	63	1.75	1.89	2.16
B66-10479	Goddard	53	2.13	1.85	2.47
B66-10600	Argonne	50	2.44	2.18	2.38
B66-10691	Goddard	119	2.54	1.90	2.64
B67-10089	Marshall	79	1.65	1.67	1.82
B67-10141	Marshall	51	1.96	1.66	2.08
B67-10197	Lewis	302	2.27	1.86	2.49
B67-10200	SNPO	191	1.87	1.75	2.11
B67-10282	Marshall	91	1.74	1.74	1.98
B67-10301	Marshall	73	1.60	1.63	1.96
B67-10340	Lewis	98	2.03	1.69	2.33
B67-10374	Marshall	71	1.63	1.58	2.03
B67-10440	Marshall	149	1.78	2.09	2.07

TABLE A-7. DISTRIBUTION OF GREATEST REQUEST FREQUENCY FOR THE 89 MOST FREQUENTLY REQUESTED TSP'S, BY INDUSTRY

Industry	Manuals	Materials	Biomed.	Electronic	Testing	Mgmt.	Total
Electrical Machinery	438	354	123	350	155	80	1,500
Educational Services	132	142	348	68	35	12	737
Chemicals	165	363	21	19	17	14	599
Nonelectrical Machinery	254	121	11	94	56	49	585
Federal Government	164	112	124	71	51	19	541
Individuals	229	63	36	42	42	7	419
Transportation Equipment	141	122	24	33	48	18	386
Instruments	112	51	59	66	49	21	358
All Other Industries	604	549	213	163	164	83	1,776
TOTALS	2,239	1,877	959	906	617	303	6,901

TABLE A-8. REQUESTS BY INDUSTRY FOR THE 89 MOST FREQUENTLY REQUESTED TSP'S

SIC	Industry	Manuals	Materials	Biomed.	Electronic	Testing	Mgmt.	Total
	Individuals	229	63	36	42	42	7	419
10	Metal mining	6	4	0	0	2	0	12
12	Bituminous coal and lignite mining	4	1	0	0	0	1	6
13	Crude petroleum and natural gas	18	5	2	2	3	2	32
15	Building construction--general contractors	2	1	0	1	0	2	6
16	Construction other than building--general contractors	6	0	0	0	1	0	7
19	Ordnance and accessories	5	6	2	3	4	0	20
20	Food and kindred products	2	6	2	0	0	1	11
22	Textile mill products	7	20	0	2	4	0	33
23	Apparel and other finished products made from fabricated materials	3	1	1	0	1	1	7
24	Lumber and wood products except furniture	12	2	0	1	2	5	22
25	Furniture and fixtures	7	6	0	0	1	1	15
26	Paper and allied products	4	19	0	1	1	5	30
27	Printing, publishing, and allied industries	16	11	0	8	3	4	42
28	Chemicals and allied products	165	363	21	19	17	14	599
29	Petroleum refining and related industries	14	17	1	1	1	2	36
30	Rubber and miscellaneous plastics products	27	66	3	6	8	3	113
32	Stone, clay, glass and concrete products	41	36	1	14	15	5	112
33	Primary metal industries	74	60	0	7	25	6	172
34	Fabricated metal products, except ordnance, machinery, and transportation equipment	82	41	1	16	24	7	171
35	Machinery, except electrical	254	121	11	94	56	49	585
36	Electrical machinery, equipment and supplies	438	354	123	350	155	80	1,500
37	Transportation equipment	141	122	24	33	48	18	386
38	Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks	112	51	59	66	49	21	358
39	Miscellaneous manufacturing industries	22	48	3	14	9	1	97
44	Water transportation	1	4	0	0	0	0	5
45	Transportation by air	14	4	0	0	1	0	19

TABLE A-8 (Continued)

SIC	Industry	Manuals	Materials	Biomed.	Electronic	Testing	Mgmt.	Total
46	Pipe line transportation	5	1	0	1	1	0	8
48	Communication	2	2	0	3	0	2	9
49	Electric, gas and sanitary services	7	2	0	1	3	3	16
50	Wholesale trade	43	30	2	9	11	9	104
55	Automotive dealers and gasoline service stations	2	4	0	1	1	1	9
67	Holding and other investment companies	10	5	0	4	0	3	22
72	Personal services	6	1	0	2	3	0	12
73	Miscellaneous business services	67	66	25	30	11	7	206
80	Medical and other health services	3	7	127	8	4	1	150
82	Educational services	132	142	348	68	35	12	737
89	Miscellaneous services	83	52	28	26	23	19	231
91	Federal Government	164	112	124	71	51	19	541
92	State Government	5	6	11	2	2	2	28
93	Local Government	0	1	4	0	0	0	5
94	International Government	4	2	0	0	0	0	6
	TOTALS	2,239	1,877	959	906	617	303	6,901

TABLE A-9. ORIGIN OF THE 89 MOST FREQUENTLY REQUESTED TSP'S IN EACH CATEGORY BY TRANSFER MECHANISM

	Manuals	Materials	Biomed.	Electronics	Testing	Mgmt.	Total
Ames Research Center	0	5	8	1	1	0	15
Argonne National Laboratory	1	0	0	2	0	0	3
Electronics Research Center	0	0	0	1	0	0	1
Flight Research Center	0	0	1	0	0	0	1
Goddard Space Flight Center	0	2	0	3	1	0	6
Kennedy Space Center	2	0	1	0	2	1	6
Langley Research Center	1	0	0	3	0	0	4
Lewis Research Center	4	4	0	1	4	2	15
Manned Spacecraft Center	0	0	0	1	0	1	2
Marshall Space Flight Center	15	2	0	3	5	0	25
Space Nuclear Propulsion Office	1	0	0	0	0	2	3
Jet Propulsion Laboratory	0	2	2	2	2	0	8
TOTALS	24	15	12	17	15	6	89

TABLE A-10. NUMBER OF THE 89 MOST FREQUENTLY REQUESTED TSP'S IN EACH CATEGORY BY TRANSFER MECHANISM

	Manuals	Materials	Biomed.	Electronics	Testing	Mgmt.	Total
Ames Research Center	0	374	837	35	52	0	1,298
Argonne National Laboratory	67	0	0	130	0	0	197
Electronics Research Center	0	0	0	31	0	0	31
Flight Research Center	0	0	50	0	0	0	50
Goddard Space Flight Center	0	403	0	251	27	0	681
Kennedy Space Center	139	0	33	0	59	57	288
Langley Research Center	32	0	0	174	0	0	206
Lewis Research Center	163	1,088	0	39	241	74	1,605
Manned Spacecraft Center	0	0	0	50	0	76	126
Marshall Space Flight Center	1,560	113	0	107	263	0	2,043
Space Nuclear Propulsion Office	453	0	0	0	0	120	573
Jet Propulsion Laboratory	0	132	94	161	58	0	445
TOTALS	2,414	2,110	1,014	978	700	327	7,543

APPENDIX B. LIST OF THE 89 MOST FREQUENTLY REQUESTED TECHNICAL SUPPORT PACKAGES BY TECH BRIEF TITLE AND NUMBER*

1. MANUALS, HANDBOOKS, SPECIAL STUDIES, NEW DESIGNS

66-10011 Torque Wrench Designed for Restricted Areas.

66-10449 Basic Suppression Techniques Are Evaluated.

66-10520 Pyrometry Handbook Describes Practical Aspects of Surface Temperature Measurements of Opaque Materials.

67-10023 Tests Show That Aluminum Welds Are Improved by Bead Removal.

67-10088 Experimental Scaling Study of Fluid Amplifier Elements.

67-10089 Materials Data Handbooks Prepared for Aluminum Alloys 2014, 2219, and 5456, and Stainless Steel Alloy 301.

67-10141 Study to Minimize Hydrogen Embrittlement of Ultrahigh-Strength Steels.

67-10200 Workmanship Standards for Fusion Welding.

67-10210 Environmental Study of Miniature Slip Rings.

67-10282 Materials Data Handbook, Inconel Alloy 718.

67-10301 Materials Data Handbook, Aluminum Alloy 7075.

67-10374 Handbooks Describe Eddy Current Techniques Used in Non-destructive Testing of Metal Parts and Components.

67-10401 Metal Tube Reducer is Inexpensive and Simple to Operate.

67-10425 Study Made of Anodized Aluminum Circuit Boards.

67-10437 Study Made of Pneumatic High Pressure Piping Materials /10,000 PSI/

67-10438 Review of Research and Development in Fluid Logic Elements.

67-10440 Fluid Properties Handbook.

67-10451 Study Made of Procedures for Externally Loading and Corrosion Testing Stress Corrosion Specimens.

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*Included in this list are TSP's with a questionnaire response level of 50 or more.

67-10465 Study Made of Transfer of Heat Energy Through Metal Joints in Vacuum Environment.

67-10555 Study Made of Heat Transfer and Pressure Drop Through Tubes with Internal Interrupted Fins.

67-10601 Analytical Drafting Curves Provide Exact Equations for Plotted Data.

67-10610 Handbook of Cryogenic Data in Graphic Form.

68-10026 Predicting Fatigue Life of Metal Bellows.

68-10046 Survey of Fracture Toughness Test Methods.

2. NEW MATERIALS OR NEW USES OF MATERIALS

65-10156 Inorganic Paint is Durable, Fireproof, Easy to Apply.

66-10373 Bearing Alloys with Hexagonal Crystal Structures Provide Improved Friction and Wear Characteristics.

66-10453 Thermoplastic Rubberlike Material Produced at Low Cost.

66-10467 Xenon Forms Stable Compound with Fluorine.

66-10471 Copper-Acrylic Enamel Serves as Lubricant for Cold Drawing of Refractory Metals.

66-10479 Electroless Nickel Plating on Stainless Steels and Aluminum.

66-10682 Primary Cells Utilize Halogen-Organic Charge Transfer Complex.

67-10006 Complex Surfaces Plated by Thin-Film Deposition in One Operation.

67-10016 Dispersion of Borax in Plastic is Excellent Fire-Retardant Heat Insulator.

67-10133 Xenon Fluoride Solutions Effective as Fluorinating Agents.

67-10441 Newly Developed Foam Ceramic Body Shows Promise as Thermal Insulation Material at 3000 deg. F.

67-10185 Xenon Fluorides Show Potential as Fluorinating Agents.

67-10197 New Class of Thermosetting Plastics Has Improved Strength, Thermal and Chemical Stability.

67-10227 Photosensitive Filler Minimizes Internal Stresses in Epoxy Resins.

67-10340 High-Strength Tungsten Alloy with Improved Ductility.

3. BIOMEDICAL DEVICES

64-10171 Subminiature Biotelemetry Unit Permits Remote Physiological Investigations.

65-10203 Tiny Biomedical Amplifier Combines High Performance, Low Power Drain.

66-10057 Miniature Bioelectric Device Accurately Measures and Telemeters Temperature.

66-10515 Apparatus Enables Automatic Microanalysis of Body Fluids.

66-10534 Miniature Piezoelectric Triaxial Accelerometer Measures Cranial Accelerations.

66-10536 Helmet System Broadcasts Electroencephalograms of Wearer.

66-10549 Miniature Electrometer Preamplifier Effectively Compensates For Input Capacitance.

66-10624 Miniature Telemetry System Accurately Measures Pressure.

66-10649 Spray-On Electrodes Enable ECG Monitoring of Physically Active Subjects.

67-10005 Digital Computer Processing of X-Ray Photos.

67-10239 A Phonocardiogram Simulator.

67-10669 Ultraminiature Manometer-Tipped Cardiac Catheter.

4. ELECTRONIC COMPONENTS, CIRCUITS, SUBSYSTEMS, AND SYSTEMS

66-10309 High-Performance RC Bandpass Filter is Adapted to Miniaturized Construction.

66-10315 System Locates Randomly Placed Remote Objects.

66-10473 Miniature Valve Accurately Controls Small Volume Fluid Flow.

66-10486 Solid State Circuit Controls Direction, Speed, and Braking of DC Motor.

66-10600 High Frequency Wide-Band Transformer Uses Coax to Achieve High Turn Ratio and Flat Response.

66-10602 Exposure Value /EV/ System Expanded to Include Filter Factors and Transmittance.

66-10617 Improved Memory Word Line Configuration Allows High Storage Density.

66-10660 Process Produces Accurate Registry Between Circuit Board Prints.

66-10664 Packaging of Electronic Modules.

66-10691 Solid-State Recoverable Fuse Functions as Circuit Breaker.

67-10038 Residual Magnetism Holds Solenoid Armature in Desired Position.

67-10151 Electronic Frequency Discriminator.

67-10152 Means for Improving Apparent Resolution of Television.

67-10289 Wideband, High Efficiency Optical Modulator Requires Less Than 10 Watts Drive Power.

67-10446 Battery Charge Regulator is Coulometer Controlled.

67-10469 Ultraminiature Television Camera.

67-10558 Solid State Single-Ended Switching DC-to-DC Converter.

5. NON-BIOMEDICAL TESTING TECHNIQUES, TEST EQUIPMENT, INSTRUMENTS, GAUGES, ETC.

65-10023 Miniature Stress Transducer Has Directional Capability.

66-10178 Fatigue Cracks Detected and Measured Without Test Interruption.

66-10302 Simple Scale Interpolator Facilitates Reading of Graphs.

66-10447 Semiconductors Can be Tested Without Removing Them from Circuitry.

66-10537 Gage Tests Tube Flares Quickly and Accurately.

67-10072 An Improved Soft X-Ray Photoionization Detector.

67-10076 Cleanroom Air Sampler Counts, Categorizes, and Records Particle Data.

67-10216 Electron Beam Welder X-Rays its Own Welds.

67-10286 Liquid Crystals Detect Voids in Fiberglass Laminates.

67-10361 Pocket-Size Manual Tape Reader Device Aids Computer Tape Checking.

67-10428 Ultrasonics Used to Measure Residual Stress.

67-10482 Surface-Crack Detection by Microwave Methods.

67-10505 Thin Film Thermal Detector.

67-10507 Test and Inspection for Process Control of Monolithic Circuits.

67-10574 Nondestructive Testing Techniques Used in Analysis of Honeycomb Structure Bond Strength.

6. COMPUTERIZED MANAGEMENT TECHNOLOGY

66-10426 Computer Simulation Program is Adaptable to Industrial Processes.

67-10025 Computer/PERT Technique Monitors Actual Versus Allocated Costs.

67-10240 Vis-A-Plan (Visualize a Plan) Management Technique Provides Performance-Time Scale.

67-10261 Analytical Technique Permits Comparison of Reliability of Alternate Mechanical Designs.

67-10348 Computerized Parts List System Coordinates Engineering Releases, Parts Control, and Manufacturing Planning.

67-10510 Probabilistic Approach to Long Range Planning of Manpower.

Bureau Budget Approval No. 104-R0043

EXHIBIT I - QUESTIONNAIRE

University of Denver
COLORADO SEMINARY

DENVER RESEARCH INSTITUTE UNIVERSITY PARK, DENVER, COLORADO 80210

QUESTIONS CONCERNING THE TECHNICAL SUPPORT PACKAGE

1. How did you learn about the availability of the technical support package you requested?

   ☐ Tech Brief
   ☐ regular recipient of other NASA publications
   ☐ trade press (Please specify) _____
   ☐ professional journal (Please specify) _____
   ☒ personal contact
   ☐ Small Business Administration
   ☐ State Technical Services
   ☒ other _____

2. How would you evaluate the support package which you received? Place (1) by the most appropriate answer and (2) by secondary answer, if any.

   ☐ of no value
   ☐ increased my knowledge of state-of-the-art
   ☒ not applicable to my work
   ☐ provided information of limited value to my work
   ☒ provided information of great value to my work
   ☐ resulted in a commercial product or new process
   ☐ other _____

3. Do you think the information might have use to you or your organization in the future?

   ☐ yes ☒ no

   Please state why or why not. _____

4. Approximately how many hours did you and other members of your organization devote to reviewing, studying, or applying the information? _____

5. How would you rate the information you received on the following factors?

	Completeness	Clarity	Usefulness
Excellent	____	____	____
Good	____	____	____
Fair	____	____	____
Poor	____	____	____

   Comments (Use reverse side if necessary) _____

6. Are any of the above responses to be considered proprietary information? If yes is checked, no information will be identified with you or your firm.

   ☐ yes ☐ no

   _____
   Your Name

— — — — — — — —